SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE OF APPLIED STUDIES
IN BELGRADE

MASTER APPLIED STUDIES

MULTIMEDIJA ENGINEERING

DBBT
Digital Broadcasting & Broadband Technologies

Belgrade, 2018.

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AND COMPUTER ENGINEERING OF
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General information

In the past couple of years, during the process of digitalization of television in Serbia and the region, and the development of the market in of modern telecommunication services, it has been recognized that there is a need for education of personnel which implies the improvement of the knowledge and specialized professions needed in the course of dynamic development of technique and technology in the field of multimedia engineering. The convergence of information technology, telecommunications, consumer electronics, multimedia and entertainment is an industrial trend which causes the creation of new services, opens the way to new business models and is an important impetus of the economic development. Nowadays, for the successful works in these areas experts are required who have the capacity to integrate knowledge from different fields and the ability to quickly acquire new knowledge.

The study program of master applied studies Multimedia Engineering was accredited in September 2017. It is intended for students who have completed basic studies in the field of audio and video technologies, electronics and telecommunications or information technologies, but also for those who want to acquire knowledge in these areas and specialize in engineering tasks related to the production or transmission of audio, video and multimedia content. The scope of master studies is 120 ECTS.

The accredited program of master applied studies is multidisciplinary, and with the system of elective subjects, it is possible to individually formulate professional specialization according to the needs, preferences and knowledge of students. By studying at this program, students have the opportunity to expand and improve their knowledge in the field of audio, video, multimedia and modern communication technologies with emphasis on digital communication technologies. Through the group of subjects including Methods of research, applied research work and Master work the knowledge and skills necessary for the research and development in this field are encouraged and developed, namely the skills necessary for the self-monitoring and participation in technological development.

Master Applied Studies Multimedia Engineering was created thanks to the partnership of School of Electrical and Computer Engineering of Applied Studies in Belgrade (VISER) in the international Erasmus + project in the area of capacity building in the field of higher education: **Implementation of the study program – Digital Broadcasting and Broadband Technologies (Master studies) - 561688-EPP-1-2015-1-XK-EPPKA2-CBHE-JP.** The curriculum and program of master Applied studies Multimedia Engineering was developed on the basis of analysis of curricula in the field of audio and video technologies, multimedia, and telecommunications in the European Union and the world. In the preparation of plans and programs partners from business field were engaged but also members of the project team from four European universities / institutes:

Polytechnic University in Madrid,

University of Ljubljana,

Technological Institute in Tatru and

Technical University in Ostrava.

In addition to the introduction of master professional studies in the field of multimedia engineering, the main objective of this project is the formation of a professional master of electrical and computer engineering in the field of multimedia engineering.

Aim of study program

The aim of the Multimedia Engineering program is to enable students to expand, improve and integrate knowledge as well as to apply acquired knowledge in the solving of specific tasks and problems in the field of multimedia and telecommunications, giving them the basis for career development and advancement in the profession.
Students will be trained in the advanced maintenance, exploitation and installation of multimedia and communication subsystems and systems, which is reflected in the ability to quickly and effectively solve practical problems in this field, as well as to independently monitor the development of the area, that is, the introduction and installation of new technologies. Special emphasis is given to the theoretical and practical knowledge in the field of signal systems and technologies.

Structure of study program

Master Applied Studies, 4 semesters, 2 years - 120 ECTS.
Students elect 10 out of 17 electives, and compulsory subjects are: Research Methods, Professional Practice 1, Professional Practice 2, Applied Research Work and Master Work.

Students` competences

It is necessary that master engineers of applied studies are familiar with different multimedia, information and communication technologies in order to offer optimal solutions to the current and future needs of employers. In addition, their ability to apply the acquired knowledge in practice is important, to solve quickly and efficiently specific problems posed by users, as well as to develop the ability of creative thinking in team or independent work.

Master Applied Studies prepare students for:
development and application of basic knowledge in specialized areas of multimedia engineering with knowledge of all phases of implementation;
identifying and solving problems of multimedia engineering;
keeping pace with the ongoing development of modern systems of multimedia engineering;
understanding of the legal, ethical and social implications of multimedia engineering projects;
efficient multimedia communication;
development of the sense of professionalism and the teamwork as well as the efficient work in a multidisciplinary environment.

Students will be trained for:

advanced maintenance, exploitation and installation of multimedia and communication subsystems and systems, which is reflected in the ability to quickly and efficiently solve specific practical problems in this field; monitoring, on their own, of the development in the area, namely the introduction and installation of new technologies. Special emphasis is given to the theoretical and practical knowledge in the field of signal systems and technologies.
With the completion of the studies, a wide range of occupations in digital TV, radio, internet, animation and graphics, studio work and various media are offered.

Syllabus of study program Multimedia Engineering

No.	Course Title	Semester	ECTS
FIRST YEAR			
1.	Research Methods	1	6
2.	Audio and video compression	1	8
3.	Digital communication systems	1	8
4.	Audio devices and systems	1	8
5.	Video devices and systems	1	8
6.	Interactive multimedia	1	8
7.	Digital radio and TV technologies	2	8
8.	Wireless systems technologies and protocols	2	8
9.	Signal processing	2	8
10.	Audio and video production systems	2	8
11.	Multimedia postproduction	2	8
12.	Student internship 1	2	6
Total ECTS			60
SECOND YEAR			
1.	Broadcasting systems and technologies	3	8
2.	Multimedia internet transmission	3	8
3.	Communications standards and technologies	3	8
4.	Studio design	3	8
5.	Telecommunication measurements	3	8
6.	Student internship 2	3	6
7.	Entrepreneurship and Incentives in Electrical and Computer Engineering	4	6
8.	Electronic communication regulation	4	6
9.	Applied research work	4	8
10.	Postgraduate/Master thesis work	4	16
Total ECTS			60

The first year courses schedule

No.	Course Title	S	Type	Course Status	Teaching hours				other	ECTS
					L	E	AFT	ARW		
1.	Research Methods	1	C	compul-sory	2	2	0	0	0	6
Elective courses block 1										
	Audio and video compression	1	C	elective	3	3	0	0	0	8
	Digital communication systems	1	C	elective	3	3	0	0	0	8
	Audio devices and systems	1	CA	elective	3	3	0	0	0	8
	Video devices and systems	1	CA	elective	3	3	0	0	0	8
2.	Interactive multimedia	1	CA	elective	3	3	0	0	0	8
Elective courses block 2										
	Digital radio and TV technologies	2	C	elective	4	3	0	0	0	8
	Wireless systems technologies and protocols	2	C	elective	4	3	0	0	0	8
	Signal processing	2	C	elective	4	3	0	0	0	8
	Audio and video production systems	2	CA	elective	4	3	0	0	0	8
3.	Multimedia postproduction	2	CA	elective	4	3	0	0	0	8
4.	Student internship 1	2	CA	compul-sory					12	6

The second year courses schedule

No.	Course Title	S	Type	Course Status	Teaching hours				other	ECTS	
					L	E	AFT	ARW			
SECOND YEAR											
Elective courses block 3											
	Broadcasting systems and technologies	3	CA	elective	4	3	0	0	0	8	
	Multimedia internet transmission	3	C	elective	4	3	0	0	0	8	
	Communications standards and technologies	3	C	elective	4	3	0	0	0	8	
	Studio design	3	CA	elective	4	3	0	0	0	8	
5.	Telecommunication measurements	3	CA	elective	4	3	0	0	0	8	
6.	Student internship 2	3	CA	compulsory					12	6	
Elective courses block 4											
	Entrepreneurship and Incentives in Electrical and Computer Engineering	4	AO	elective	3	3	0	0	0	6	
7.	Electronic communication regulation	4	C	elective	3	3	0	0	0	6	
8.	Applied research work	4	CA	compulsory	0	0	0	16	0	8	
9.	Postgraduate/Master thesis work	4	CA	compulsory					32	16	
Total number of teaching hours (lectures+exercises AFT(additional forms of teaching), ARW (applied research work), other classes) and points per year					15	12	0	16	44	60	
Total number of teaching hours per study year					43x15=645						
Total number of teaching hours, other classes and points for all study years					86x15=1290				120	120	

Book of the Courses

Course Title	Research Methods
Status	Compulsory
ECTS	6
Content	Theoretical studies: 1. Introduction, plan and work program 2. Science definition 3. Science development 4. Scientific research methodology 5. Research organisation 6. Research Methods 7. Data collection methods 8. Data processing methods 9. General and special scientific methods 10. Scientific- vocational work structure 11. Scientific result types 12. Writing and publishing scientific work 13. Writing specialist (expert) work 14. Scientific results evaluation 15. Fianl observations, analysis, self-evaluation Practical teaching The exercises follow the lectures. Writing and oral defense of seminar papers.
Learning outcomes	Upon successful completion of this course, students will be able to successfully carry out the selection and definition of the theme, as well as planning and organization of writing and oral presentation of scientific-vocational and specialist works.
Bibliography	1. Милосављевић Славољуб, Радосављевић Иван: Основи методологије политичких наука, Службени гласник Србије, Београд, 2008, 2. Ристић Ж.: О истраживању, методу и знању, Институт за педагошка истраживања, Београд, 2006. 3. Бпгдан Шешић: Општа методологија, Научна књига, Београд, 1980. 4. Карл Попер: Логика научног открића, Нолит, Београд, 1975.
Methodology	Lectures, exercises, consultations, writing and oral defense of seminar papers
Software/ Equipment	
Lectures	2
Exercises	2
Laboratory exercises	0
Other	0
Pre-Exam (Points)	70 (Lectures activities – 5 points, Practical work – 15 points, Seminar(s) – 50 points)
Exam (Points)	30

Course Title	Audio and Video Compression
Status	mandatory
ECTS	8
Content	1. Introductory lecture. Course content and organization. 2. Multimedia application and their requirements for storage and transport. 3. Introductions to audio and video signals: analog and digital representations, human perception. 4. Information theory, lossless compression, Huffman coding, arithmetic coding. 5. Quantization: uniform, non-uniform, vector. Predictive methods: DPCM, adaptive DPCM, DM. 6. Transformation methods: time, space, frequency, DFT, DCT. 7. Filter based and wavelet- based compression of audio and video signals. 8. Motion compensation, motion vectors and block matching. 9. Space, time, static, view redundancy in compression. 10. MPEG-1 standard, MPEG-2 – television standard (SDTV and HDTV), MPEG audio standards. 11. H.261, H.262 and H.263 standards. 12. MPEG-4 multimedia standards, H.264 AVC or MPEG-4 version 10 for DVB over IP and DVB-H 13. 3D video (MVC, SBS, FS coding). 14. H.265 video standard. 15. Real time compression for video streaming. 16. Concluding remarks. Directions of further professional development, self-evaluation of the course. Laboratory exercises include work in a free software FFMPEG that has wide range of educational and professional applications, by creating the video using HD web cameras or using existing videos and their further processing and compression. Additionally, laboratory exercises include work in educational software Image and Video Compression Learning Tool VcDemo, where is possible to change parameters of compression, such as bit rate, predictive structure in DPCM, block sizes in DCT and GoP organization in MPEG. Laboratory work includes digitalization parameters and compressions of audio signal, by using digital audio recorder and later compression of audio. As a final part of exercises, H.265 video coding is analyzed using a hardware HEVC encoder.
Learning outcomes	At the end of the course, students will be familiar with the principles of audio and video compression using a basic and the state-of-the-art compression standards, and their practical applications in communication systems.
Literature	1. A. Zekovic, Audio and Video Compression – pdf Lectures for Audio and Video Compression course, VISER, Beograd, 2015. 2. M. Popovic, Digitalna obrada slike, Akademska misao, Beograd, 2015. 3. Video Coding Experts Group (VCEG) MPEG-x standards, (http://www.itu.int/en/ITU-T/studygroups/2013-2016/16/Pages/video/vceg.aspx) 4. H.26x video standards, (http://mpeg.chiariglione.org/standards). 5. P. Symes, Digital Video Compression, McGraw-Hill, 2004. 6. V. Bhaskaran, K. Konstantinides, Image and Video Compression Standards: Algorithms and Architectures, Springer, 1997.
Methodology	Lectures, problem solving sessions, laboratory exercises, consultations, colloquiums, seminar, final exam.
Software/ Equipment	Software: FFMPEG, Image and Video Compression Learning Tool VcDemo, x265 ; Hardware: headphones, web cameras, HEVC encoder
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 20 points, Colloquium(s) – 20 points, Seminar – 20 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Digital Communication Systems
Status	elective
ECTS	8
Content	1. Introductory lecture, Course overview 2. Signal types, signal characterisation in time and frequency domain, Nyquist's theorem. 3. Error control coding principles, CRC 4. Modulation and multiplexing 5. Channel effects on transmission, Transmission media 6. Circuit switching vs. packet switching, network topologies, layered network model 7. Data link layer and Ethernet 8. IP Addressing and Routing 9. Transport Layer protocols TCP and UDP 10. IP Support Protocols: ARP, DHCP, ICMP 11. Application Layer Protocols: DNS, SMTP, POP, IMAP, FTP, HTTP 12. RTP and Vo IP 13. IP version 6 14. Firewalls and NAT,VLANs, VPNs, Proxy servers 15. Concluding remarks. Practical/laboratory work follows the theoretical instruction topics: signal analysis, modulation formats, error control coding, protocol analysis, basic configuration of network devices and troubleshooting.
Learning outcomes	Upon successful completion of this course, students will be able to explain the principles of digital communication systems and computer networks and to perform basic configuation of network devices as well as basic testing and troubleshooting in IP networks.
Literature	1. V. Vasiljević, Računarske mreže, Visoka škola elektrotehnike i računarstva, Beograd, 2007 2. Tanenbaum Andrew S., Computer Networks, 4th edition 3. William Stallings, Data and Computer Communications, 8th Edition
Methodology	Lectures, problem solving sessions, laboratory exercises, consultations, colloquiums, final exam.
Software/ Equipment	Matlab, Wireshark, spectrum analyzer, routers, switches
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Audio devices and systems
Status	elective
ECTS	8
Content	Theoretical classes / lectures 1. Analog audio devices and systems: history, classification and application 1 2. Analog audio devices and systems: history, classification and application 2 3. Digital audio devices and systems: theoretical bases, development, classification and application 4. Digital audio formats 5. Audio mixers 6. Audio signal processing 1 7. Audio signal processing 2 8. Audio signal processing 3 9. Audio system: connecting, signal flow and grounding 10. Audio monitoring: formats and implementation 11. Microphones: dividing and application 12. Audio signals measurement 13. Wireless audio devices and systems 14. Live sound audio devices and systems 15. Broadcasting audio devices and systems Problem solving sessions/Lab work/ Practical training: Practical training program follows the lecture.
Learning outcomes	At the end of this course students will know theoretical basics and audio devices and systems advanced appliance technics.
Literature	1. M. Mijić: Audio sistemi, Akademska misao, Beograd, ISBN 2011, 978 86 7466032 2. A. Nisbett: The Sound Studio, Focal Press, Oxford, 2003, ISBN 0 240 51911 6 3. J. Eargle: The Microphone Book, Focal Press, Burlington, USA,, 2005 , ISBN 02405 1961 2
Methodology	Lectures and laboratory work.
Software/ Equipment	Pro Tools/ microphones, mixer, loudspeakers
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70
Exam (Points)	30

Course Title	Video devices and systems
Status	elective
ECTS	8
Content	1. Theoretical principles and historical development of video devices and systems 2. Video formats 3. Video production switchers 4. Video routersw 5. Video signal processing devices 6. Video measurement and analysis devices 7. Studio cameras 8. Devices and systems for the broadcasting of TV program – part 1 9. Devices and systems for the broadcasting of TV program – part 2 10. Studio lighting – part 1 11. Studio lighting – part 2 12. Connecting video devices and systems 13. Field production cameras and lights 14. Television studio 15. OB truck
Learning outcomes	After completing the course, students will be able to understand and work with all devices installed in any television system.
Literature	1. Mile Petrović, Ivana Milošević, Handbook for laboratory exercises in Television systems and video technologies, VISER, 2015. 2. Ivana Milošević, Mirko Milošević, Handbook for laboratory exercises in Studio and field TV production, VISER, 2015. 3. M. S. De Alencar, Digital Television systems, Cambridge University Press, 2009. 4. M. Moshkovitz, The Virtual Studio Technology and Techniques, Focal Press, 2010. 5. R. Musburger, Single-Camera Video Production, Focal Press, 2010. 6. H. M. Ozaktas, L. Onural, Three-Dimensional Television, Springer-Verlag, Berlin-Heidelberg, 2009.
Methodology	Lectures, laboratory exercises.
Software/ Equipment	Devices and software used in modern television systems.
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Interactive multimedia
Status	elective
ECTS	8
Content	**Theoretical instruction:** 1. Introduction, concepts, terms and types of multimedia contents. 2. 3D geometry, types - polygonal and NURBS objects. Primitives, tools. 3. Polygonal modeling. 4. Shaders, materials, textures. Attributes. UV mapping. Principles, tools. 5. Map preparations for texturing. Exporting maps. 6. Lighting in movies and computer games. 7. Camera, composition, framing, shot types. 3D cameras – types, attributes. 8. Rendering - image finalization, Maya software render, Mental Ray render 9. Concept of interactivity and interactive contents - types, application, software and engines. 10. Character and prop design. 11. Game design 12. Traditional media elements in computer games and their specifics. 13. Specific elements in computer games 14. Video games classifications and genres, target groups, motives. 15. Predictions and further computer game development - 3D, VR.. **Practical instruction:** Polygonal 3D objects, modeling basics, model construction. Tools. ;Polygonal modeling with reference; UV mapping; Creating textures and texturing polygonal objects; 3D lights - types and attributes; 3D cameras. Setting and camera animation, path animation; Rendering - Mental Ray renderer, parameters and settings; Introduction to Unity 3D, software for making computer games; Preparation of materials and project for a computer game; Creating an interactive environment and elements in Unity 3D; Lighting a scene in Unity 3D; Cameras and animation in Unity 3D; Sound design for a video game; Exporting a game for different platforms.
Learning outcomes	Students will know how to realize various multimedia tasks that consider very high aesthetic professional standards in the area of computer graphics.
Literature	1. Callios, Roger , Man, play and games 2. Pardew, Les Beginning Illustration and Storyboarding for Games 3. Russo, Mario, Polygonal Modeling: Basic And Advanced Techniques, Wordware Publishing, 2006. 4. Childs, G.W. IV Creating Music and Sound for Games 5. Birn, Jeremy., Digital Lighting And Rendering, New Riders, USA, 2000. 6. https://unity3d.com/learn
Methodology	Theory - oral, video projections. Practical - demonstrative, video projections, individual work
Software/ Equipment	Maya 3D, Unity 3D, Adobe Photoshop, Adobe Animate, Adobe Illustrator
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	50
Exam (Points)	50

Course Title	Digital radio and TV technologies
Status	elective
ECTS	8
Content	1. Radio and television systems (understanding basic concepts and designs). 2. Understanding differences between low-cost and high-reliability systems. 3. HD and UHD equipment: production switchers, cameras, servers, routers, various converters, embedders, de-embedders, multiview systems. 4. Design and implementation of HD and UHD TV systems. 5. Regulations and television standards for HD, UHD and 3D equipment. 6. Standards. ITU- R BT 601/656. G722. G722.1. AAC-LD. 7. HD image compression using H.265/HEVC standard. Coding of HD and UHD signals. Encoders and decoders. 8. 3D television systems. Auto stereoscopy. Tridimensional perception of space. 9. Standards for generating and storing HD, UHD and 3D video materials. 10. Audio data compression. Digital audio: stereo, 5.1, 22.2. 11. Audio studio equipment and technologies. 12. 3D audio. Dolby Motion Picture Matrix encoding. 13. Digital Audio Broadcasting DAB / DAB+ / DMB. 14. HD, UHD, 3D TV, DAB signal receivers (LCD, PDP, LED, 3D screens and glasses).
Learning outcomes	After completing the course, students will be able to understand and use all services, technologies and devices for producing and broadcasting radio and TV signals.
Literature	Mile Petrović, Television, FTN Kosovska Mitrovica, 2007. Mile Petrović, Ivana Milošević, Handbook for laboratory exercises in Television systems and video technologies, VISER, 2015. M. S. De Alencar, Digital Television systems, Cambridge University Press, 2009. J. Arnold, M. Frater, M. Pickering, Digital Television, Technology and Standards, 2007. Charles Poynton, Digital Video and HDTV Algorithms and Interfaces, Elsevier Science, 2003. B. Mendiburu, Y. Pupulin and S. Schklair, 3D TV and 3D cinema, Focal Press, 2010.
Methodology	Lectures, laboratory exercises.
Software/ Equipment	Devices and software used in modern radio and television systems.
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 40 points, Colloquium(s) – 20 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Wireless systems technologies and protocols
Status	elective
ECTS	8
Content	Lectures: 1. Introduction. Course overview, organisational and course con tent. Historical overview. 2. Wireless networks principles. RF propagation (amplification/attenuation), interference, fading, reflection, refraction, diffraction. Fresnel zones. 3. Antennas characteristics, types an design. 4. Modulations (DSS, FHSS, ASK, FSK, PSK) and multiplexing (FDM, TDM, OFDM) techniques. 5. Wireless Operation. Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Multi Input Multi Output Systems (MIMO), multi user MU-MIMO, beamforming. 6. Wireless networks standards and amendments: IEEE802.11, IEEE802.15, IEEE802.16. Wireless networks technologies: WiFi, WiMaX, Bluetooth, ZigBee. 7. Wireless topologies modes (ad hoc, infrastructure, mesh). Channel management (1;2.4; 5; 60GHz). Band Channel Plan and Frequency Allocations by Region. 8. Wireless networks protocols and services: Controlled Channel Access (HCCA), Enhanced Distributed Channel Access (EDCA), Control and Provisioning of Wireless Access Points Control and Provisioning of Wireless Access Points (CAPWAP). 9. IEEE802.11, Bluetooth and ZigBee frame structure and implementation. 10. Routing in wireless networks. Route Discovery. Ad hoc On Demand Distance Vector (AODV) 11. Wireless networks security and threats. Shared key authentication techniques: Wi-Fi Protected Access (WPA), IEEE 802.11i/WPA2.. 12. AAA protocols: Remote Authentication Dial-In User Service (RADIUS). Port-based network access control (IEEE802.1x), Extensible Authentication Protocol (EAP). WPA/WPA2 enterprise protection. 13. Evolution of digital mobile networks towards mobile broadband networks. Architecture, interface and protocol analysis of 2G networks. (GSM, GPRS, EDGE). 14. Analysis of 3G (WCDMA, HSPA, HSPA) and 4G networks (LTE, LTE-A). 15. Internet of things (IoT). M2M (Machine to Machine) communication systems 16. Laboratory exercises 17. Usage of antennas, cables and connectors in wireless systems. 18. Wireless link budget calculation by using simulation software for wireless links and signal propagation. Wireless access point and client administration 19. Analysis and implementing of security mechanisms in local wireless networks. Wireless network integration into corporative computer networks. Configuration of EAP-TLS and EAP-PEAP authentication.
Learning outcomes	After completing the course, students will be able to design, administer and use wireless and mobile networks.
Methodology	Lectures, laboratory excersise, practical work, continous knowledge tests, consulting, groupe projects and case studies.
Software/ Equipment	Radio Mobile, Wireshark. Kali Linux/ Wireless Acess Points, wireles NIC
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Activities during lectures 10, Laboratory work 40, knowledge tests 20),
Exam (Points)	30 (Final computer test)

Course Title	Signal Processing
Status	elective
ECTS	8
Content	1. Introduction. What is signal processing? History of signal processing, examples. 2. Visualization of signals in Excel or similar software. 3. Visualization of signals in Python. 4. Complex exponential discrete signals. Example – synthesis of musical signals. 5. Fourier analysis: Discrete Fourier transform, Fast Fourier transform, applications for spectrum analysers and oscilloscopes. 6. Filters: convolution, ideal and real filters, causality, filters design. Example – convolution in GPS systems. 7. Interpolation and sampling: continual signals, interpolation, sampling, sampling theorem. Processing of continual signals in discrete time in Simulink or similar software. 8. Stochastic signals, quantization, analog-digital conversion and digital-analog conversion. 9. Statistical processing of signals and application of statistical parameters in communication systems. 10. 2D Fourier analysis, example – image processing, filtering, JPEG compression, image enchantment in frequency domain. 11. Selection of the specific parameters and parts of signals. Example – speech recognition, face recognition. 12. Signal representation, coding and compression – as an adjustment to transport. 13. Digital communication systems: analog channels and limitations in spectra and power, modulation and demodulation. Example – analog audio systems. 14. Transport of signals in analog and digital systems, mediums for transport, signal conversions, methods for conversions. Example – video signals conversions. 15. Concluding remarks. Directions of further professional development, self-evaluation of the course. Laboratory exercises go in line with the lectures programme. Introduction to software for signal processing, such as Python, Matlab, and Excel. Visualization of data and selection of specific parts. Transformation and signal processing. Examples: spectral analysis, GSP convolution, processing of 2D signals, statistical analysis of signals.
Learning outcomes	At the end of the course, students understand and know principles of signal processing and its visualization for practical examples and possibilities of its applications.
Literature	Z. Dobrosavljević, Lj. Milić, Uvod u digitalnu obradu signala, Akademska Misao, 2009 D. Manolakis, V. Ingle, Applied Digital Signal Processing, Theory and Practice, Cambridge University Press, 2011 R. Lyons, Understanding Digital Signal Processing, Prentice Hall, 2004 J. Guttag, Introduction to Computation and Programming Using Python, The MIT Press, 2013
Methodology	Lectures, problem solving sessions, laboratory exercises, consultations, colloquiums, final exam.
Software/ Equipment	Software: Python, Excel, Matlab, Audacity; Hardware: Spectral analyser, Laptop with external graphic card (as NVidia GeForce 940M or higher)
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Audio and video production systems
Status	elective
ECTS	8
Content	Theoretical classes / lectures 1. Audio studio: production parts and organisation 2. Radio: history, technology and modern organisation 3. Audio recording in external conditions 4. TV studio production systems (informative and entertainment programme) 1: technology and organization 5. TV studio production systems (informative and entertainment programme) 2: technology and organization 6. TV recording in external conditions (sports and concerts) 1: technology and organization 7. TV recording in external conditions (sports and concerts) 2: technology and organization 8. Internet radio 9. Internet television 10. Audio and video streaming and social networks 11. Multimedial systems in theatre 12. Audio and video systems for conferences 13. Audio and video systems for concerts 14. Communication in audio and video systems: technology and realization 15. Production audio and video systems: organization and stuff structure Problem solving sessions/Lab work/ Practical training: Practical training program follows the lecture.
Learning outcomes	At the end of this course students will know theoretical basics and audio and video devices and systems advanced appliance technics in the audio and video production process.
Literature	1. M. Mijić: Audio sistemi, Akademska misao, Beograd, ISBN 2011, 978 86 7466032 2. A. Nisbett: The Sound Studio, Focal Press, Oxford, 2003, ISBN 0 240 51911 6 3. M.T.Smith: Audio Engineer's reference book, Focal press, Oxford, UK, ISBN 0 240 51528 5 4. M. Popović: Digitalna obrada slike , Akademska misao, Beograd, 2006. 5. J. Arnold, M. Frater, and M. Pickering: Digital Television, Tehnology and Standandards, 2007. 6. M. Moshkovitz,:The Virtual Studio Tehnology and Techniques, Focal Press, 2010.
Methodology	Lectures and laboratory work.
Software/ Equipment	Pro Tools, Final Cut/ microphones, mixer, loudspeakers, cameras, video monitors
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70
Exam (Points)	30

Course Title	Multimedia postproduction
Status	elective
ECTS	8
Content	**Theoretical instruction:** 1. Abstract and narrative video forms. Process of pre-production 2. Short videos and their specifics – video art, jingles, advertisements... 3. Text and text animation as means of expression. 4. Animated graphics, types and applications 5. Sound in short videos. 6. Black and white and color picture. Colors, color theory and perception. 7. Animated special effects in still images. 8. Research and development as the first step in creating a multi-media project. 9. Film language and directing short videos. 10. Special effects on videos. Analogue and digital effects. 11. Individual and team work. Advantages and disadvantages. 12. Preparations and organizing a team project – pipeline, schedule, assignments, deadlines, interdependence of the work of team members. 13. Editing short videos, length and shot transitions. **Practical instruction:** 1. Introduction to Adobe After Effects. 2. Layers, 3D layers and text animation. 3. Animating graphics. Adjustment layers. 4. Creating sounds for animated graphics. 5. Still images, cutting, filters, layers, color corrections, animation, parallaxes. 6. Working with still images, 3D effects. 7. Shooting and preparing videos for special effects. 8. Keying, green or blue screen background cutting. 9. Incorporation of cut material and the still images as backgrounds. 10. 2D effects on videos, drawing animation. 11. Cameras and camera tracking. 12. Filters, deformations, attributes and layer effects. 13. Integrating sound effects and music with videos. 14. Render preparations, formats, rendering.
Learning outcomes	Students will know how to realize multimedia tasks of very high aesthetic professional standards in the area of audio and visual arts, opening credits, end credits, video spots and short movies containing different video effects.
Literature	1. Erijon, Daniel, Grammar of the film language, Универзитет Уметности, Београд, Студентски културни центар, Београд, 1998. 2. Krasner, Jon, Motion Graphic Design: Applied Jistory and Aesthetics, Elsevier, Oxford, 2008. 3. Kim, Gerard, Designing virtual reality Systems: The structured approach, Springer, 2005. 4. Rush, Michael, New Media in Art, Thames, Hudson, 2005. 5. Anderson, Stephen P., Seductive interactive design, New Readers Press, 2011.
Methodology	Theory - oral, video projections. Practical - demonstrative, video projections, individual work
Software/ Equipment	Adobe Photoshop, Adobe After Effects
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	50
Exam (Points)	50

Course Title	Student Internship 1
Status	mandatory
ECTS	6
Content	Practical teaching: During the course of student internship 1 in the second semester, students are fully involved in solving the tasks assigned in the field of digital broadcasting and broadband technolgies. Collaborating with their mentor, students devise ways of solving the assigned practical tasks, implement them and evaluate the outcomes. They attend team meetings and actively participate in choosing the methods and approaches to solve the assigned tasks. Independently yet under the mentor's supervision, students execute practical activities for the company's current projects. They apply contemporary methods and technologies adapted to the specific means at company's disposal. Under their mentor's guidance, they propose and implement micro-surveys with the aim of improving existing solutions. While doing so, they keep notes of the internship and ultimately write reports.
Learning outcomes	Upon successful completion of this practical course, students will be able to: 1. Independently carry out the selection methods for solving the assignments in the field of digital broadcasting and broadband technologies as a part of the internship with companies allied to the higher education institution. 2. independently plan and implement various kinds of activities for solving the assignments 3. Contribute the improvement of existing solutions by proposing and participating 4. Closely collaborate with mentor and team members in solving given problems
Literature	
Methodology	Mentoring, consultation, preparation for practice and practice in companies engaged in electrical engineering.
Software/ Equipment	
Lectures	0
Exercises	0
Laboratory exercises	0
Other	12
Pre-Exam (Points)	Practical work – 50 points, Seminar(s) – 20 points
Exam (Points)	30

Course Title	Broadcasting systems and technologies
Status	elective
ECTS	8
Content	1. Digital transmission technologies and systems. 2. Source coding and multiplexing. 3. Transport stream. Channel coding. 4. Digital TV modulation. 5. Primary and secondary distribution systems. 6. Different radio and television signal distribution and broadcast platforms. 7. Understanding broadcast distribution chain. 8. RF systems, Rx and Tx antennas, signal propagation. 9. Technologies for signal distribution over DVB-C platform. Design and implementation of DVB-C system. 10. Technologies for signal transmission over DVB-T/T2 platform. Design and implementation of DVB-T/T2 system. 11. Technologies for signal transmission over DVB-S/S2 platform. Design and implementation of DVB-S/S2 system. 12. Digital Audio Broadcasting (DAB). 13. Digital multimedia broadcasting (DMB). 14. Hybrid Broadcast/Broadband TV (HbbTV). 15. Measuring and understanding Modulation Error rate, Bit error rate before and after FEC.
Learning outcomes	After completing the course, students will be able to understand and use technologies and devices for broadcasting of digital radio and TV signals in any format and on any platform.
Literature	1. Dušan Marković, DVB-T: Digital terrestrial television, Akademska misao, 2008. 2. Mile Petrović, Handbook for laboratory exercises in Multimedia TV distribution systems, VISER, 2009. 3. J. Arnold, M. Frater, M. Pickering, Digital Television, Technology and Standards, 2007. 4. J. C. Whitaker, Postgraduated/Master ing digital television, McGraw-Hill, 2006. 5. DVB Standards, http://www.dvb.org/standards
Methodology	Lectures, laboratory exercises.
Software/ Equipment	Devices and software used in modern broadcasting systems.
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 40 points, Colloquium(s) – 20 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Multimedia internet transmission
Status	elective
ECTS	8
Content	1. IP systems architecture. 2. Digital processing of speech signal. Telephone signal. Bitrate of telephone signals. 3. Transmission of speech and video over IP. Internet protocols: TCP, UDP, ARP, DNS, RTP, RCP, SCTP. 4. IP QoS control mechanisms. 5. IP multimedia subsystems (IMS). 6. VoIP software. Protocol architecture for VoIP. 7. Audio over IP (AoIP). Voice over IP (VoIP). 8. Codecs and standards (G.711, G.726, G.729, G.723). 9. Digitalization of video signal. 10. Static and moving picture compression: JPEG, MPEG-4, HEVC/H.265, H.264. 11. Standards implementation for transmission and compression of audio and video signals over Internet and wireless networks: H.26x, MPEG-1, MPEG-2 and MPEG-4. 12. Video telephone and video conference transmission of picture and sound over Internet. 13. Integrating TV systems and Internet technology (IPTV). 14. Internet television. Hybrid television. Web television. 15. Multimedia IP services.
Learning outcomes	After completing the course, students will be able to understand and use IP technology for transmission of multimedia content.
Literature	1. Mile Petrović, Ivana Milošević, Handbook for laboratory exercises in Television basics, VISER, 2016. 2. Ž. Markov, Modern telephone technology, 2005. 3. V. Vasiljević, Computer networks, VISER, 2008. 4. European Regulatory Group, ERG Common Statement for VoIP regulatory approaches, 2012. 5. R. M. Perea, Internet Multimedia Communications Using SIP, Elsevier, 2008. 6. L. Parziale, D. T. Britt, C. Davis, J. Forrester, W. Liu, C. Matthews, N. Rosselot, TCP/IP Tutorial and Technical Overview, Redbooks, IBM, 2006. 7. A Tutorial on Audio Contribution over IP, N/ACIP, 2008.
Methodology	Lectures, laboratory exercises.
Software/ Equipment	Devices and software used in IP based systems.
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 40 points, Colloquium(s) – 20 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Communication Standards and Technologies
Status	elective
ECTS	8
Content	1. Opening lecture (the organization and content of the course, connections with other courses, goals, and methods). 2. What is a communication standards? History overview. Technical, regulatory and economic aspects of communication standards. 3. Reliability and quality of service in infrastructure (communication and electronic power systems). 4. Propagation of information in wire and wireless systems. Communication standards on physical level in wire systems. 5. Audio and video standards (JPEG, MPEG, H.26x, 3D). 6. Network types (LAN, MAN, WAN), broadband services and applications. Basics of transport in data networks: ARP, DNS, DHCP, TCP, UDP, IP. 7. IP Multimedia Subsystem (IMS), VoIP and IPTV 8. Broadband cable access (xDSL, ADSL, HDSL, RADSL, VDSL, DSLAM, DOCSIS) 9. Hybrid fiber-coaxial (HFC) 10. Optical networks (WDM, DWDM, components, networking). Optical broadband access (G-PON, B-PON, E-PON) 11. Cable Television – CATV 12. Hybrid Broadcast Broadband TV – HbbTV 13. Wireless broadband communication standards: IEEE 802.11 and additional proprietary wireless standards, IEEE 802.11n, 802.11ac, fixed wireless broadband: WiMAX (IEEE 802.16). 14. Standards for mobile communication networks (LTE, Mobile WiMAX). Mobile OTT services. 15. Concluding remarks. Directions of further professional development, self-evaluation of the course. During the laboratory exercises, students will get familiar with practical aspects of application of standards in communication networks, especially conversions of audio and video standards.
Learning outcomes	At the end of the course, students will understand principles of communication standards, their practical applications and possibilities of conversions of standards as well as principles of broadband technologies.
Literature	1. S. Gorshe, A. Raghavan, T. Starr, Stefano Galli, Broadband Access: Wireline and Wireless - Alternatives for Internet Services, Wiley, 2014. 2. Roger L. Freeman, Telecommunication System Engineering, John Wiley & Sons, 2004 3. Michael Gendron, Business Driven Data Communications, Prentice Hall, 2012 4. http://www.ratel.rs
Methodology	Lectures, problem solving sessions, laboratory exercises, consultations, colloquiums, final exam.
Software/ Equipment	Software: DiviSuite software for DVB C/C2 and additional free softwers; Hardware: DVB C/C2 measurment reciever and DVB C/C2 RF analyzer, appropriete signal receivers
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Studio Design
Status	Elective
ECTS	8
Content	1. Historical overwiev of studio development: from the early beginnings to the modern times. 2. Studio building 1: Industry standards and real-life needs. Legaslative issues. Powering studio. 3. Studio building 2: Studio sound insulation design and implementation. 4. Studio building 3: Sudio acoustic design and implementation. 5. Blok scheme standards, drawing and reading: audio, video and network installation. Installation's drawing softwares. 6. Audio studio 1: Choosing and connecting equipmnet. Comparative analysis of technical charactersistic and price/quality ratio. 7. Audio studio 2: wiring, signal flow, grounding. 8. Audio studio 3: Comprative analysis of different audio studio types needs and design. 9. Audio studio 4: Current audio equipment market analysis and up-to-date solutions for modern audio broadcast studio. 10. TV studio 1: different types of video systems, programmes and broadcasting standards. 11. TV studio design 2: Choosing and connecting equipmnet. Comparative analysis of technical charactersistic and price/quality ratio. 12. TV studio design 3: Comprative analysis of different video studio types needs and design. 13. TV studio 4: Current videio equipment market analysis and up-to-date solutions for modern videio broadcast studio. 14. Audio and video studio design: study case 1. 15. Audio and video studio design: study case 2. Laboratory work follows lectures: AutoCAD; Studio measuring procedures (acoustic and electric); Students will go through the whole process of audio and video studio design, according to pre-defined project task. They will generate all needed technical documentations, according to standards, following theoretical instruction topics.
Learning outcomes	At the end of the course students will be familiar with principles of audio and video studio design, studio building construction and acoustic treatment, proper selection and connection of studio equipment, studio systems design, as well as capable to interpretate and deliver all necessary technical documentation needed for the process of studio design.
Literature	1. P. Newell: Recording studio design, Taylor & Francis USA, 2013. 2. J. Bignel, J. Orlebar: The television handbook, Taylor & Francis, 2005. 3. R.G. Gupta: TV Engineering and Video Systems, McGraw-Hill Education, 2005.
Methodology	Theory and laboratory exercise
Software/ Equipment	AutoCad; EASE; EASERA
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30

Course Title	Telecommunication measurements
Status	elective
ECTS	8
Content	1. Introduction to measurements. Types and importance of telecommunication measurements. Examples of measurements. 2. Signal representation in time domain and frequency domain. 3. Spectrum analyzers – principle of operation. 4. Signal level measurements, signal bandwidth measurements, measurements with spectrum analyzer. 5. Modulation measurements, measurements with spectrum analyzer. 6. Noise measurements, measurements with spectrum analyzer. 7. Distortion measurements, measurements with spectrum analyzer. 8. Network analyzers - principle of operation. 9. S - Parameter measurements. 10. Phase and group delay measurements. 11. Reflectometry and reflectometer. 12. Optical transmission systems measurements. 13. BER testers. 14. Measurements in telecommunication networks. Protocol analyzers. 15. Knowledge recapitulation and concluding remarks.
Learning outcomes	At the end of the course, students will gain knowledge necessary for proper operation of measurement equipment and knowledge necessary to successfully implement measurement procedures.
Literature	1. N. Miljković, Metode i instrumentacija za električna merenja, Elektrotehnički fakultet, Univerzitet u Beogradu, 2016. 2. M. Bjelica, Telekomunikaciona merenja 1 - zbirka rešenih zadataka, Elektrotehnički fakultet, Univerzitet u Beogradu, 2013. 3. Witte A. Robert, Spectrum and Network Measurements, SciTech Publishing edition 2006. 4. Rauscher C., Fundamentals of Spectrum Analysis, Rohde & Schwarz, 2006. 5. Time Domain Reflectometry Theory, Application Note, Agilent Technologies, Inc. 2000-2013 Published in USA, May 31, 2013
Methodology	Lectures, problem solving sessions, laboratory exercises, consultations, colloquiums, final exam.
Software/ Equipment	Spectrum analyzer, Oscilloscope in VISER laboratory (network analyzer and BER tester in facilities of associates from industry)
Lectures	4
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 40 points, Colloquium(s) – 20 points)
Exam (Points)	30 (Written exam – 30 points)

Course Title	Student Internship 2
Status	mandatory
ECTS	6
Content	Practical teaching: During the course of student internship 2 in the fourth semester, students are involved in the planning and implementation of the project in a company which is engaged in broadcast and telecommunication engineering. Students with the help of mentors and team members implement the tasks of the project. Attend working meetings where the team is actively involved in the formation of the decision given on the application of technologies and methods. In cooperation with team members apply different procedures for monitoring and recording of project development. Included in the evaluation and self-evaluation process of implemented project tasks. Keep a diary of intership and at the end of course write a report.
Learning outcomes	Upon successful completion of this course, students will be able: 1. To express independence and creativity in the choice of methods and technologies to solve a given task 2. To actively and responsibly participate in the work of the team on solving problems and to propose the implementation of new technologies 3. To their proposals and direct participation contribute to the successful implementation of projects within the company where they perform intership 4. To contribute, in cooperation with mentor and other team members, to a better quality solution of the task
Literature	
Methodology	Mentoring, consultation, preparation for practice and practice in companies engaged in electrical engineering.
Software/ Equipment	
Lectures	0
Exercises	0
Laboratory exercises	0
Other	12
Pre-Exam (Points)	Practical work – 50 points, Seminar(s) – 20 points
Exam (Points)	30

Course Title	Entrepreneurship and Incentives in Electrical and Computer Engineering
Status	elective
ECTS	6
Content	Theory 1. Foundations of entrepreneurship, define importance and role of the entrepreneur across the world. 2. Entrepreneurship as systematic process of applying creativity and innovation. 3. Designing a competitive business model and feasibility analysis. 4. Develop a strategic plan and sustainable competitive advantage. 5. Entrepreneurship and the management of information technology systems. 6. Principles of building marketing plan. 7. Creating a successful financial plan. 8. Test (Colloquium) 9. Develop a business plan. 10. Creating a winning business plan presentation and apply for funding. 11. Launch a successful business. 12. Electrical and computer engineering and communication and business skills. 13. Licenses, certificates, patents. 14. Test (Colloquium) 15. Student project presentations and the defense of the project. Practice Computer lab hands on training. Illustrate theoretic lessons with real life examples and business software tools.
Learning outcomes	Understand all phases in starting up businesses, form creative ideas and business plans to effective business launching. Postgraduated/Master ing skills in business software tools suitable for successful business implementation, including simulation and modeling of business logic and procedures.
Literature	1. N.M. Scarborough, J.R. Cornwall, Essentials of Entrepreneurship and Small Business, 8th edition, Pearson, USA, 2015. 2. M. Lutovac, D. Tošić, Biznis plan za elektronsko poslovanje, VISER, Beograd, 2007 3. Starting your start-up 1-5, IEEE-USA E-books, 2016. 4. Shaping an Engineering Career, IEEE-USA E-books, 2016. 5. IEEE on licensing software engineers, IEEE-USA E-books, 2016. 6. Launching Your Career: How to Find Your Perfect Job, IEEE-USA E-books, 2012.
Methodology	Theory and laboratory exercise
Software/ Equipment	
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Practical work – 30 points, Colloquium(s) – 30 points)
Exam (Points)	30

Course Title	Electronic Communications Regulation
Status	elective
ECTS	6
Content	Theoretical studies: 1. Introduction. Regulation significance, goals, principles and structure. 2. International organizations and national regulation bodies. 3. Legislation and EU regulatory framework (directives, standards and recommendations). 4. The Law on Electronic Communications (principles, objectives, scope) and compatibility with international regulations. 5. Individual act, which closely establish specific areas of electronic communications. 6. The regulation of electronic communications networks I (Broadcasting and Wireless). 7. The regulation of electronic communications networks II (cable and optical). 8. Radio-frequency spectrum - RF spectrum management, Allocation plan, Distribution plan, RF spectrum use and control. 9. RF spectrum based electronic communications services regulation. 10. Other electronic communications services regulation. 11. Numbering as a limited resource, and number portability. 12. Universal service. 13. Connection between electronic communications regulations and other regulations in order to ensure users rights protection, electronic communications confidentiality, lawful data interception and retention. 14. Regulatory Challenges (NGN, IoT, OTT, 5G, ...). 15. Skills recapitulation and summary. Auditory classes: Auditory classes follow a program of lectures.
Learning outcomes	Upon completion of the course, students will have required knowledge about the current national regulations relating to electronic communications, the regulatory challenges set by rapid development of new technologies and services, as well as organizations involved in regulations in this area
Literature	*[1] Закон о електронским комуникацијама ("Службени гласник Републике Србије", број 44/10, 60/13-УС и 62/14)* *[2] Directives 2009/136/EC and 2009/140/EC of the European Parliament and of the Council, 25 November 2009* *[3] Directive 2002/21/EC of the European Parlament and of the Council, 7 March 2002, (Framework directive), OJ [2002] L 108/33 as amended by Directive 2009/14.* *[4] Directive 2002/20/EC of the European Parlament and of the Council, 7 March 2002 (Authorisation directive), OJ [2002] L 108/21 as amended by Directive 2009/14.* *[5] Directive 2002/19/EC of the European Parlament and of the Council, 7 March 2002 (Access directive), OJ [2002] L 108/7 as amended by Directive 2009/14.* *[6] Directive 2002/22/EC of the European Parlament and of the Council, 7 March 2002 (Universal Service directive), OJ [2002] L 108/51 as amended by Directive 2009/136.* *[7] Commision Decision 2002/622 of 26 july 2002 establishing a Radio Spectrum Policy Group, OJ [2002] L 198/49.*
Methodology	Teaching is organized through lectures, auditory and laboratory exercises.
Software/ Equipment	
Lectures	3
Exercises	0
Laboratory exercises	3
Other	0
Pre-Exam (Points)	70 (Lectures activities – 10 points, Colloquium(s) – 20 points, Seminar(s) – 40 points)
Exam (Points)	30

Course Title	Postgraduated/Master Thesis Work
Status	Mandatory
ECTS	16
Content	General facilities: Postgraduated/Master thesis work on the Postgraduated/Master vocational studies represent the practical research work of students where students apply the acquired knowledge in the field of digital broadcasting and broadband technologies and research methodology. Postgraduated/Master 's thesis is a project which solves a practical problem in the field of digital broadcasting and broadband technologies, which was accepted by the respective companies and higher education institutions in which the student is studying. Postgraduated/Master thesis is made in companies with which the higher education institution has a contract. Once adopted theme of the Postgraduated/Master thesis, students make study research project which must be approved by a mentor. After that, the student, in the framework of applied research activities, conducts research and writes a report on the research conducted in the form of a seminar paper. After passing the exam in Applied Research Postgraduated/Master student writes a paper that contains the results of applied research. Postgraduated/Master thesis contains the following sections: Introduction, theoretical part, experimental part, results and discussion, conclusion, literature review, contributions. After completing the work, the student in consultation and coordination with the supervisor access to the public defense of the final work. Member of the commission for the defense of the final work is representative of the company in which the candidate realizes Postgraduated/Master thesis.
Learning outcomes	It is expected that the students develop the following competencies: 1. Ability of students to apply theoretical and empirical research methods in the field of digital broadcasting and broadband technologies; 2. ability of students to identify, shape methodological, theoretical and empirical explore practical problems in companies engaged in broadcast and telecommunication engineering; 3. develop the ability of students to improving the application of telecommunication engineering in companies.
Literature	4.
Methodology	Mentoring and individual students research
Software/ Equipment	
Lectures	0
Exercises	0
Laboratory exercises	0
Other	32
Pre-Exam (Points)	Writing Postgraduated/Master thesis work – 70 points
Exam (Points)	30

ABOUT THE SCHOOL

College of Electrical Engineering in Belgrade was founded in 1974. The founder of the school is the Republic of Serbia. Preparations for the transformation and accreditation of College of Electrical Engineering in the status of school of applied studies began in 2001. Since September 2007, the School has been operating as a School of Electrical and Computer Engineering of Applied Studies and has so far accredited:

8 study programs of basic studies,
6 study programs of specialist studies and
3 study programs of master applied studies.

VISER also participates in international projects within the TEMPUS and ERASMUS + programs, thanks to which a number of new educational technologies have been implemented, the curriculum has been modernized and a comprehensive exchange of good practice has been realized within the project consortium and the goals of single projects.
With accreditation of three master study programs VISER encompassed the knowledge and skills that enabled the further continuation of studies for all candidates who successfully completed basic applied studies.

SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE OF APPLIED STUDIES

IN BELGRADE

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DBBT
Digital Broadcasting & Broadband Technologies